Context Awareness: Supporting Humans Engaged in the Creative Process

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ABSTRACT

Computer prosthetics have been shown to support human processes ranging from writing, to the dynamic stability and trajectory planning of space craft. The specific exploration here is the computational s support of humans engaged in creative processes. Several systems and designs for an interactive bed, a dynamic feedback arm sleeve, and a gesture based musical improvisation tool are presented to show the emergence of diverse methods for computers supporting creativity. These systems as a whole represent wearable, biometric, collaborative and ubiquitous computing approaches that show new ways for user models and context aware computing to enhance human computer interaction and impact the creative process. The foundations of this approach come from user interface design, product design, and the psychophysical aspects of creativity research and motivational theory.

KEYWORDS

Creativity, Ubiquitous Computing, Captology, Peak Performance, Context Aware Computing, Physiology.

INTRODUCTION

This work focuses on the topic of creativity and ubiquitous interface design, exploring the diverse role of computational tools, especially contextually aware tools, within the creative process. These tools are dispersed within one's environment and range in function from those that promote generative and evaluative tasks to ones that enhance capabilities, communication, resource utilization, and other synergistic productivity and creativity enhancements. Two sub-topics that have a significant bearing on computer enhanced creativity, Captology (computer assisted persuasive technology) and Peak Performance, will also be discussed. [1] The work discussed here draws upon the principals of captology to enhance the engagement and benefit of users with persuasive technologies. The tools that make us peak performers are those tools that extend users' abilities to exploit any and all internal and external resources toward a focused goal. These tools address both mental and physiological processes with the goal of generating or bringing a user closer to a state of "flow".[2] The specific goal of this line of research is to show the synergy of contextually aware computational tools, ubiquitous computer human interface, and supporting humans engaged in the creative process.

Human Computer Interface is the central discipline that couples the desires and capabilities of an individual or group with the capabilities of technology and strives to mediate the interaction. In order to enhance human creativity through the use of technology it is essential to have a deep understanding of Computer Human Interface design and in terms of experimentation process, current findings and best practices. In dealing with creative-computing we are particularly interested in the area of context aware computing. [3,4] Sensor technologies and interface design are reaching a level of sophistication in which it is ever more possible to create dramatic applications that interact with users to substantially enhance their creative potential. [5] The creative process is composed of a myriad of elements ranging from social and environmental elements to the specifics of the problem solving process. [6,7]

The importance and relevance of the use of technology for creative problem solving and invention can only be adequately understood within the broader contextual areas of the diverse fields which contribute to research on creativity: psychological, sociological, neurological, and environmental factors. [6] It can also be informed by the meta-creativity approach in which programs “accumulate” past experiences and information, “reflect” on them and “transfer” this information throughout the system, an approach promoted by Bruce Buchanan as a means for enhancing creative collaboration between machine and user. [8]

Peak Performance deals with how the findings of these perspectives contribute to productivity, motivation and most importantly, in this case, creative output. Specifically we manipulate elements of motivation: physical; social; and emotional environments using contemporary creativity research approaches [9,6].

Through this contextual understanding, rich new technological interactions can be appropriately constructed with the aspiration of beneficial impact on the generative processes.

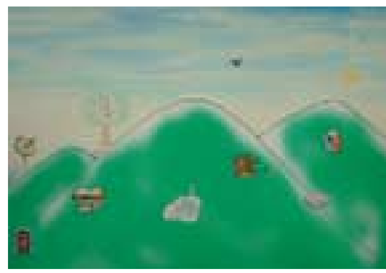
Captology is the study of computer assisted persuasive technology. [1] This field is also particularly important to the advancement of several elements of creative computing in that it's roots in behavior modification have the potential to create a lasting impact in changing the individual, their creative process, and in turn society. We will explore the lessons form this emerging field and see how they can be applied to the development of applications that enhance human creativity.

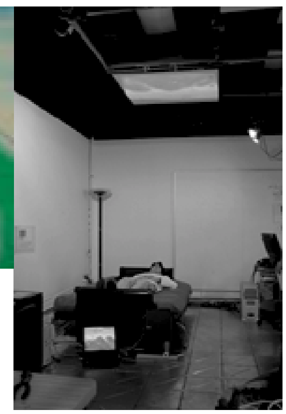
APPROACH TO SYSTEMS AND DESIGN IMPLIMENTATION

We develop new ways to use technology to enhance human creativity from the perspectives of a strong understanding of HCI design and product design engineering, coupled with a focused support from the research literature pertaining to creative process and technological interactions to support creativity

TEST BED:

The idea of "Flow: the development of optimal experience", is promoted by Mihaly Csikszentmihalyi and Howard Gardner among other psychological researchers pursuing creativity and optimal experience. [2] They maintain that there are necessary environmental, social, and mental elements are required for achieve a flow state.





What we attempt in the Test Bed is to be observant enough, through diverse sensors, to create a contextual recognition of the state of the user. More and more, computers will be responsible for understanding user needs without explicit direction. The system understands contextual states and adjusts to the user to create optimal experiences: comfort; education; entertainment; health; and productivity (recording dreams, communicating by phone or writing, planning), based on past histories of interactions. The bed has the ability to modify the environmental features in an attempt to create the necessary social, and potentially mental elements for users to achieve goals, and potentially achieve flow states.

The Test Bed is a computer system that understands what a person is doing in bed and gives appropriate, helpful interactions. It "listens" to many information channels of sensors to create its user model, including time and knowledge of the position of the user, sound, as well as direct user input. The bed consists of an integrated personal computer and video projector. The Test Bed runs a Macromedia Director movie projected onto the ceiling above a standard bed. This projection creates a world that provides the user with a space for interaction. The Test Bed is a place for us to experiment with new scenarios for using a computer in our lives and a place to experiment with new input devices. Finally a person in bed has different personal needs and priorities than when out of bed

A typical Test Bed Scenario: A person is lying on the Test Bed. Many simple activities can be facilitated from the computer to make lying in bed more pleasurable and productive. A scene appears, projected on the ceiling above the user's head (Figure). It is a scene of rolling hills dotted with icons: an e-mail kiosk, a TV satellite dish, a juke box, a person reading in a lawn chair, a newspaper stand, the moon and stars, and the sun. Each of these icons can move the user into another part of the world depending on his needs and wishes at the time.

By picking up a gesture ball, a beanbag the size of a golf ball, the user is able to control the position of a small red ball in the projected world. This red ball acts as a cursor to help facilitate the user's interaction. Deciding to check e-mail, the user moves the ball over the e-mail kiosk (Figure). The kiosk enlarges to fill the screen, bringing the user into another space. A smaller rendition of the rolling hills at the top of the screen points to the original main screen where the user came from. The user can similarly watch TV, read the newspaper or read an online book on his ceiling. When reading something or watching TV or a movie, the user no longer has to prop themselves up on their arms or find a comfortable position to sit in.

Once the user has finished reading his e-mail, he then moves the red ball cursor onto the hills to return to the initial selection screen. It's time to go to sleep, so the user moves to the moon and stars, where he is presented with a soothing song, and a sunset that gradually darkens to reveal the night sky. The bed can subtly and playfully encourage a person to go to bed at an hour that they should by shifting to this mode as well. Moving the ball over the moon presents the outlines of constellations. As the user explores the night sky, the names of the constellations and planets appear. Moving over a planet brings up its path and other information. This is an example of how the system can function in an educational and informational role as well. As the user falls asleep, the bed recognizes the hour, and sets sunrise to accommodate the user's sleep patterns. The bed has learned how long he/she likes to sleep by monitoring the use patterns of the alarm clock. Since the bed has access to the user's calendar, it knows the user will not miss any appointments by waking up at eleven o'clock. In the morning, the sun rises on the ceiling, accompanied by morning music. The room is gradually lit up by "sunlight", and the day's schedule is presented for review along with e-mail, newspaper, and a dream log customized to the user's interests and preferences. In these scenarios the user is able to enjoy the activities that they normally enjoy with the assistance of media and computer assistance.

This is an example of a system that can "accumulate" past experiences and information, "reflect" on them and "transfer" this information throughout the system to enhance usability and promote calm computing, and flow states which are often precursors to creativity. [8,10,2]

FLEXOR:

Flexor is a sleeve that enhances a person's expressive capability based on a model of the user's arm movements. When a person is moving her arm as though she is dancing, it makes sounds and flashes a varying sequence of lights. When she is moving her arm as though she is exercising, Flexor counts how many repetitions are completed. In this way, Flexor is an example of context-aware computing in which a model of what a person is doing allows the computer to help that person without any explicit interaction from the user. This mode can be further explored in giving the user confidence and motivation to engage in social interaction. Once Flexor is activated in the social engagement mode if one is inactive for a specified period Flexor can flash its lights and make sounds indicating its "desire" to be engaged. This alerts the person wearing Flexor that they should go and meet someone or dance. In this case if Flexor is not being used it requests to be used. In this way it is supportive of the users goal for social engagement and performance based entertainment. Wearing the Flexor to a party is an example of endogenous captology technology [1].

Typically we wear jewelry on our bodies both for ourselves and for the effect it has on others. As we move into the digital age we find ourselves using digital technology on wearable things. This work explores explicit, dramatic, and audacious uses of lights and sounds in a wearable computer that augments one's personal expressive manner. With Flexor we are trying to accomplish context-awareness based on a single elbow bend sensor and time. In contrast to wearable games such as the Data Glove[11] giving feedback on a TV, Flexor is an integrated display. It is designed with electro-luminescent displays sewn into it. Along the length of the Flexor is a force-sensing variable resistor. The computer that controls the lights and sounds of the armband is housed in a pouch at the top of the sleeve. The "brain" for the Flexor is a PIC microchip which controls a RC-circuit creating an analog converter that measures the resistance and change in resistance over time of the force-sensing resistor. The change in resistance tells the computer the angle the arm is bent or if it is bent at all.

The commercially available interactive doll "Baby Think It Over"[12] achieves some of these objectives; requiring it's user to feed it and change its diapers. Later dolls have employed tilt, pressure, noise, and light sensors to achieve greater interactivity and realism. The real power of Flexor is distinguishing several complete scenarios (social motivation, performance, and physical therapy) from a single sensor input. Previous body position work in this area includes the CellSpot system [13] used to track body motion for animation production and refinement of an athletes physical form (a tennis serve, or golf swing).

Using a single sensor, a robust user model, and dramatic output we are able to motivate people to engage in ways and frequencies that are enhanced by the Flexor arm sleeve technology.

MUSICAL GESTURE BALL:

The “reward for novelty” approach from Applied Behavior Analysis can be used as a motivating framework for generative tasks and as "training" for activity and idea generation ”flexibility”. This was shown with Karen Pryor’s work with dolphin training in the 1960’s [14,15] and has progressed since then. This method gives a reward for every novel behavior in the hopes of developing an expansive behavioral repertoire. The Musical Gesture Ball is a system which starts off as a “blank slate”. Users interact with the computer by making gestures and the computer responds by auditioning sounds to associate with the gestures. Through this collaboration a gesture/sound repertoire is developed and fully customized to each user. Users’ improvisations are supported with suggestions by the computer from the gesture/sound repertoire. This support is both visual and acoustical. On screen representations of the gestures are available, and when chosen the sounds are sequenced with the ongoing composition. In the generative phase the repertoire development can be treated as a collaborative mutually reinforcing ABA session in which the user is rewarded for generating new gestures and the computer is rewarded for auditioning appreciated sounds to associate to the gestures. In the composition and performance phase the collaboration is more interactive and supportive; the user makes gestures and the computer suggests progressions from its embedded knowledge of music.

CONCLUSION

These examples show a range of ways in which ubiquitous computing tools especially those that are contextually aware can enhance a user's task performance, generate a flow state, and in some circumstances increase creativity. The synergies of simple yet rich sensing environments and appropriate feedback methods have shown the power to transform not only human computer interaction, but human to human creative interactions as well.

The goal of developing substantial new forms of creative-computing can be achieved through: integration of HCI expertise; improvement of sensor and contextual computing frameworks; and increased understandings of behavior modification and peak performance; as well as appreciation of the diverse perspectives and applications of creativity research. It is with these goals in mind that we created the Test Bed, Flexor, and Musical Gesture Ball interfaces too explore the expanse of wearable, ubiquitous and collaborative systems that can impact creativity. In the Test Bed users interact with a system that has the capability to create an adaptable user model and act in contextually aware ways. It also has the potential to engage its user in diverse calm computing and flow states on environmental and motivational levels. The Flexor arm sleeve shows how a single wearable biosensor can enhance physical activity and be used to support both generative performance and social interactions. The Musical Gesture Ball improvisational tool shows how a creative and motivational collaboration with a computer can ensue even with a novice musician. These systems are a few of those being developed in the Context Aware Computing Lab. They represent some of the initial findings of embedded technologies in support of context awareness and creativity.

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